

California State University, San Bernardino

CSUSB ScholarWorks

Theses Digitization Project

John M. Pfau Library

1997

The development of a curriculum for a course in manipulative skills for shielded metal arc welding

Jay Miller

Follow this and additional works at: <https://scholarworks.lib.csusb.edu/etd-project>



Part of the [Vocational Education Commons](#)

Recommended Citation

Miller, Jay, "The development of a curriculum for a course in manipulative skills for shielded metal arc welding" (1997). *Theses Digitization Project*. 1188.

<https://scholarworks.lib.csusb.edu/etd-project/1188>

This Project is brought to you for free and open access by the John M. Pfau Library at CSUSB ScholarWorks. It has been accepted for inclusion in Theses Digitization Project by an authorized administrator of CSUSB ScholarWorks. For more information, please contact scholarworks@csusb.edu.

THE DEVELOPMENT OF A CURRICULUM FOR A COURSE IN
MANIPULATIVE SKILLS FOR SHIELDED METAL ARC WELDING

A Project
Presented to the
Faculty of
California State University,
San Bernardino

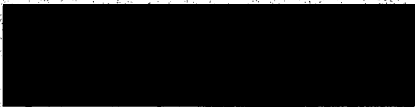
In Partial Fulfillment
of the Requirements for the Degree
Master of Arts
in
Education: Vocational Education

by
Jay Miller
June 1997

THE DEVELOPMENT OF A CURRICULUM FOR A COURSE IN
MANIPULATIVE SKILLS FOR SHIELDED METAL ARC WELDING

A Project
Presented to the
Faculty of
California State University,
San Bernardino

by
Jay Miller
June 1997
Approved by:


Allen D. Truell, Ph. D., First Reader

5/12/97
Date


Ronald K. Pendleton, Ph.D., Second Reader

ABSTRACT

This project is a guide for the training and qualification of entry level students in the shielded metal arc welding process. The guide is a course outline containing a course description, content in terms of specific body of knowledge, course objectives, methods of instruction, methods of evaluation, topics and class hours, required reading, evaluation, and grading scale. The course outline will state the knowledge/skills the student should have acquired after successfully completing this course. The guide is complete with a description of performance objectives describing behavior expected of the instructor and students, assignments, and record of achievement. This project specifies a credible path and guidelines for the training and qualification of a trainee entering the welding profession. Successful completion of the objectives in this project will enable the trainee to progress to the next level of welder training.

ACKNOWLEDGMENTS

I would like to acknowledge the support of my immediate family. Specifically, my wife, Jeannie Miller, for the support in completing this project and the other trials and tribulations of life. My two sons, Leeland Jay Vaccaro Miller and Aaron Jean Miller, for giving me the joy and inspiration to provide for them. I would also like to thank the core of the Vocational Education Department, Dr. Allen Truell, and Dr. Ronald Pendleton for showing me the way to successfully achieve my goals. Without the dedication of these people this project and many other things would not have been possible for me to attain.

TABLE OF CONTENTS

ABSTRACT	iii
ACKNOWLEDGMENTS	iv
CHAPTER ONE--Background	1
Introduction	1
Context of the Problem	1
Purpose of the Project	2
Significance of the Project	3
Limitations and Delimitations	3
Limitations	3
Delimitations	3
Definitions of Terms	3
Organization of the Project	6
CHAPTER TWO--Review of the Literature	7
Introduction	7
Historical Developments of Welding	7
The Electrical Arc	8
Major Technical Developments	9
Computers and Robotics	9
Summary	10
CHAPTER THREE--Methodology	11
Introduction	11

Population Served	11
Curriculum Development	11
Curriculum Structure	11
Content Validation	12
Existing Programs	12
Summary	13
CHAPTER FOUR--Budget	14
Introduction	14
Budget Outline	14
Summary	14
CHAPTER FIVE--Conclusions and Recommendations	15
Introduction	15
Conclusions	15
Recommendations	15
Summary	15
APPENDIXES: Welding Curricula	16
Appendix A: Existing Outline--Hobart Welding School	17
Appendix B: Existing Outline--Lincoln Welding School	21
Appendix C: Existing Outline--Palomar College	25
Appendix D: Proposed Outline--Palomar College	30
REFERENCES	43

CHAPTER ONE

Background

Introduction

The contents of Chapter One presents an overview of the project. The context of the problem is discussed followed by the purpose and significance of the project. Next, the limitations and delimitations that apply to this project are reviewed. Finally, a definition of terms is presented.

Context of the Problem

Welding pervades our lives in the business, home, and industry. In fact, welded objects contribute to the final outcome of nearly 50% of the United States Gross Manufacturing Product (The American Welding Society, 1993). Members of both, industry and the welding society are concerned with where and how the next generation of master welders will be trained to meet the demands and growth of technology. Representatives from the American Welding Society forecasts a 5% increase in the number of welders needed between 1990 and 2005 (The American Welding Society, 1993). Stringent codes and procedures will have to be met to weld the modern configurations of exotic space aged metals. Further, the nonprofessional welder (e.g., artist, auto mechanic, autobody repairman, electrician) using welding to enhance their trade or project should be proficient in the knowledge and skills of the welding process. Professional and nonprofessional welders who receive valid occupational training will meet the demands of the 21st century.

A review of past and present literature and video of welding instruction resources show that teaching methods and techniques have not changed considerably since the

advent of modern welding. The authors of books are able to describe and illustrate the methods of manipulating various electrodes. However, they cannot produce the actual process and the physical parts of the weld pool that produces the desired weld. Welders' ability to distinguish those parts and boundaries from one another, use them as guides during the welding process, along with the ability to physically manipulate the joining of the weld material and the base metal using a welding electrode determine the degree of skill as a welder that the person has attained. Those skills will also determine the ability of welders to progress to a higher level in the profession. This situation has increased the need for a well defined curriculum in the fundamentals of shielded metal arc welding and an acceptable means of conveying the necessary information.

Shielded metal arc welding has been an option in the Palomar College vocational curriculum since 1956. Since 1956 and through the early 1990's , education in shielded metal arc welding consisted of conventional instructor demonstrations. The curriculum for shielded metal arc welding has not been updated in the Palomar College curriculum since 1985. Thus, the written curriculum is considerably different from what is actually being taught in the laboratory. This situation has increased the need for a well defined shielded metal arc welding course.

Purpose of the Project

The purpose of this project was to design a one-semester course curriculum that would clearly show the student the proper electrode manipulation in shielded metal arc welding for entry level trainees. Specifically, the curriculum will serve students at Palomar College in San Marcos, California. The content of the curriculum consists of safety, welder performance, welding theory, and inspection.

Significance of the Project

The current shielded metal arc welding curriculum is not sufficient to show the student the proper electrode manipulation to produce satisfactory welds. This curriculum will provide the student with the skills necessary to gain and maintain meaningful employment or the ability to graduate to a higher level of welding skill.

Limitations and Delimitations

A number of limitations and delimitations surfaced during the development of this project. These limitations and delimitations are presented in the next section.

Limitations. The following limitations apply to this project.

1. The welding course was developed based on the equipment available at the Palomar College welding department.
2. The welding course was developed based on the materials and supplies available at Palomar College welding department.

Delimitations. The following limitations apply to this project.

1. The techniques that were developed for this project focus on shielded metal arc welding.
2. The electrodes used for demonstration in this project are E-6013, E-6010, and E-7018.
3. The metal and electrodes used in this project are designed for carbon steel.

Definition of Terms

The following terms are defined as they apply to this project.

Actual throat--The shortest distance between the weld root and the face of a fillet weld.

Arc length--The distance from the tip of the welding electrode to the adjacent surface of

the weld the weld pool.

Axis of weld--A line through the length of the weld, perpendicular to and at the geometric center of its cross section.

Base metal--The metal or alloy that is welded, brazed, soldered, or cut.

Crater--A depression in the weld face at the termination of a weld bead.

Crown--The highest point of the face of the exposed weld.

Defect--A discontinuity or discontinuities that by nature or accumulated effect render a part or product unable to meet minimum applicable standards of specifications.

Discontinuity--An interruption of the typical structure of a material, such as a lack of homogeneity in its mechanical, mechanical, metallurgical, or physical characteristics. A discontinuity is not necessary a defect.

Drag angel--The travel angle when the electrode is pointing in a direction opposite to the progression of welding.

Electrode--A component of the electrical circuit that terminates at the arc, molten conductive slag, or base metal.

Entry level welder--An individual employed in this position is considered to possess a prerequisite amount of knowledge, attitude, skills, and habits required to perform procedures that involve routine, predictable, repetitive, proceduralized tasks involving motor skills, and limited theoretical knowledge while working under close supervision.

Fillet weld--A weld of approximately triangular cross section joining two surfaces approximately triangular cross section joining two surfaces approximately at right angels to each other.

Flux--A material used to hinder or prevent the formation of oxide and other undesirable substances in molten metal and on solid metal surfaces, and to dissolve or otherwise facilitate the removal of such substances.

Pass--A single progression of welding along a joint. The result of a pass is a weld bead or layer.

Polarity--The arrangement of electrical welding leads or selector switch on the power source that determines the direction of current flow.

Porosity--Cavity-type discontinuities formed by gas entrapment during solidification.

Push angle--The travel angle when the electrode is pointing in the direction of weld progression.

Slag--A nonmetallic product resulting from the mutual dissolution of flux and nonmetallic impurities in some welding and brazing processes.

Shielded Metal Arc Welding-- An arc welding process with an arc between a covered electrode and the weld pool. The process is used with shield shielding from the decomposition of the electrode covering, without the application of pressure, and with filler metal from the electrode.

Splatter--The metal particles expelled during fusion welding that do not form a part of the weld.

Toeline--The junction of the weld face and the base metal.

Travel angle--The angle less than ninety degrees between the electrode axis and a line perpendicular to the weld axis, in a plane determined by the electrode axis and the weld axis.

Weave--A type of weld bead made with transverse oscillation.

Weldability--The capacity of material to be welded under the imposed fabrication conditions into a specific, suitably designed structure and to perform satisfactorily in the intended service.

Welding procedure--The detailed methods and practices involved in the production of a weldment.

Welding position--The relationship between the weld pool, joint, joint members, and welding heat source during welding.

Whipping--A manual welding technique in which the arc or flame is manipulated to alternate backwards and forwards as it progresses along the weld path.

Work angle--The angle less than ninety degrees between a line perpendicular to the major work piece surface and a plane determined by the electrode axis and the weld axis.

Organization of the Project

This project is divided into five chapters. Chapter One provides an introduction to the context of the problem, purpose of the project, significance of the project, limitations and delimitations, and definition of terms. Chapter Two consists of a review of two current welding program's content delivery systems. Chapter Three outlines the population to be served and the project design. Chapter Four reviews the budget required for implementing the projects. Chapter Five presents the conclusions and recommendations gleamed from the project. The project and references follow Chapter Five.

CHAPTER TWO

Review of the Literature

Introduction

Chapter Two consists of a discussion of the relevant literature. Specifically, the historical development of welding, the introduction of the electric arc, major technical developments, and the computer age of welding is discussed. The Chapter concludes with a summary.

Historical Developments of Welding

From the Bible, in the Book of Genesis, Chapter 4, Verse 22 it says “Zillah bore Tubal-Cain; he was the forger of all instruments of bronze and iron.” From this verse, one can construe that the art of metalworking was one of the earliest forms of endeavor known to man. In fact, all of man’s higher culture rests on the development of metals and joining them by welding. In lay terms, welding is the joining of metals where the coalescence is produced from heat. For thousands of years, welding was accomplished by hammering hot metals to obtain a forge weld by molecular diffusion. The metal, copper, is very common in the earth, and being a relatively soft and ductile metal, made it easy to melt and shape by pounding with the meager tools of the era.

Probably by accident, tin was tossed into the melting pot of copper alloying it with the prime metal and the Bronze Age was born. Because of its toughness bronze quickly replaced copper in strategic areas of weaponry, tools, and hardware. Subsequently, the Iron Age did the same to the Bronze Age. The advantages of a material that was tougher and stronger than copper or bronze were utilized. The transition from bronze to iron was

rather slow because bronze implements were satisfactory and metal workers already knew how to shape the copper-tin alloy. Another transition from iron to newer space-age metals is underway. The quest for lighter and stronger materials is continuous. During the evolution of metals there naturally was a development of talent to work the new-found materials. Each new era spawned people with the skills to shape and join the new metals (The Miller Electric Manufacturing Company, 1995). The Industrial Revolution in full swing, required or prompted the advent of faster and stronger methods of joining metal along with the people with the ability to perform those tasks.

The Electrical Arc

Experiments in several areas of the world were conducted utilizing the arc provided by electricity from batteries to join metal (The Miller Electric Manufacturing Company, 1995). Finally, in 1885 the first British patent was issued for a welding process using carbon electrodes and an electric power source. The use of carbon electrodes and an electrical power source for repair welding was the primary goal of the inventors rather than a powerful fabrication process for production into which it later developed. Unfortunately the development of electricity and arc welding was slow to evolve. The theory was inferred, however, the machinery, equipment, and skills needed invention and mastership. The most limiting factor to arc welding was the electrode. The welds produced by the first electrodes were brittle due to their reaction to the atmosphere during welding (The Miller Electric Manufacturing Company, 1995). Thus, limiting arc welding to bonding metal parts with insignificant value. The advent of extruding steel into wire (electrodes) and covering them with a coating (flux) that produced a gas shield

propelled Shielded Metal Arc Welding into a profitable means for joining steel with speed and acceptability. The two world wars demanded faster production processes, especially in the shipbuilding arena. Arc welding was able to meet those demands with satisfactory results. Arc welding emerged as the most economical and substantial process for joining metals. Since World War II, the welding industry has demanded better welding machines, new processes for welding exotic metals, welding technology for joining materials considered nonweldable, and equipment for cutting. Metals, such as aluminum, magnesium, and stainless steel, that were considered exotic in World War II are commonly welded today.

Major Technical Developments

The applications for arc welding grew rapidly after World War II. Technology has kept pace with the demand for faster, versatile, and productive processes for the newer space-aged metals. Automatic welders attached to robotic arms have found employment in production line assemblies. Continuous wire feed machines squirt various welding electrode compositions at ten times the rate of the basic shielded metal arc process (The Lincoln Electric Company, 1995). Researchers have also developed exotic joining methods, such as laser welding and electron-beam welding processes that use electricity but do not employ an arc.

Computers and Robots

With more use of automated equipment and the broader application of exotic metals composites, welding students will be required to attain higher levels of competency. Though high-tech skills will not be needed for all welding applications, many jobs will

require familiarity with computers and robots. On the other hand, regardless of whether computers or robots take over welding operations in plants and on production lines, there will always be a need for skilled welders (The Lincoln Electric Company, 1995). That is, welders who physically control the welding process by manipulating the electrode thus, producing the desired weld. Though shielded metal arc welding no longer occupies preeminent positions in joining technology, it is important to note that training in this process is the basis for all other welding processes that are taught. If we impart a good understanding of the fundamentals of welding, students will be able to become expert on any of the various welding processes.

Summary

The historical developments and discoveries of arc welding were reviewed. The introduction of electricity and the electrode, and the period of rapid growth of welding technology were discussed. Lastly, the role that arc welding represents for training future welders was presented.

CHAPTER THREE

Methodology

Introduction

Chapter Three details the steps used in developing the project. Specifically, the populations served is discussed. Next, the curriculum development process including the curriculum structure and content validations is presented. Lastly, the existing programs are delineated. The Chapter concludes with a summary.

Population Served

The curriculum was developed specifically for students entering the welding profession or journeymen welders wishing to upgrade their skills. The curriculum is appropriate for use in any high school, trade school, or apprenticeship training program, since it was developed in accordance with the specifications and procedures set forth by the American Welding Society. These specifications and procedures were developed by a committee of professionals representing industry, government, and the American Welding Society.

Curriculum Development

The next section of the project provides an overview of the curriculum development process. Specifically, the curriculum structure and content validation process are reviewed.

Curriculum Structure. This curriculum was developed in accordance with the outline put forward by Palomar Community College. This outline consists of the following: (1) course number and title, (2) hours required per week, (3) units, (4) prerequisite(s), (5) course description, (6) repeatable, (7) dual listing, (8) new discipline,

(9) distant education, (10) reason for proposal, (11) overlap with other courses, (12) recommended for transfer, (13) recommended for general education requirements, (14) placement in an A.A. degree/certificate program, (15) discipline for minimum qualification, and (16) effective date. The content for this curriculum was extracted from existing programs and acquired from my experiences of an expert welder. Specific content includes safety procedures, setup of equipment and machinery, definitions of terms, techniques, testing, and inspection. There is no prerequisite for this course.

Content Validation. The content for this curriculum was validated in using two methods. One, competencies identified in the literature as essential to obtaining and maintaining meaningful employment were included in the curriculum. Two, an advisory committee in the areas of welding skills and employment were assembled. The committee reviewed the curriculum and made suggestions for modifications and improvements. The suggestions for improvement made by the advisory committee were incorporated into the curriculum. Paul Kelly, Dean of Vocational Programs at Palomar College, reviewed and approved the final draft of the curriculum.

Existing Programs

The curricula for two existing welding programs were reviewed. One, the existing program at Hobart School of Welding Technology was examined (Appendix A). The existing Hobart School of Welding Technology program offers manipulative skill training in shielded metal arc welding. Two, the existing program at Lincoln Electric Welding School was reviewed (Appendix B). The existing Lincoln Electric Welding School offers manipulative skill training in shielded metal arc welding. The existing program at Palomar College offers manipulative skill training in shielded metal arc welding and oxyacetylene

welding and cutting. Complete outlines of these existing programs follow.

Summary

The steps used in the development of this project were outlined. The population served was described as was the curriculum development process. Lastly, the existing welding programs were presented.

CHAPTER FOUR

Budget

Introduction

Chapter Four outlines the costs associated with implementing the proposed curriculum. Specific expenses are presented in the next section.

Budget Outline

MARK IV MILLER WELDING POWER SOURCES @ \$7000.00 each	\$28,000.00
28 ELECTRODE HOLDERS @ \$2.00 each	\$650.00
100 FEET OF WELDING CABLE @ \$2.00 per foot	\$200.00
28 WELDING HELMETS @ \$30.00 each	\$840.00
28 PROTECTIVE LEATHER COATS @ \$60.00 each	\$1680.00
28 PAIRS OF LEATHER WELDING GLOVES @ \$12.00 each	\$336.00
28 CHIPPING HAMMERS @ \$3.00 each	\$84.00
28 WIRE BRUSHES @ \$2.00 each	\$56.00
28 PAIRS OF SAFETY GLASSES @ \$6.00 each	\$168.00
1000 POUNDS OF ELECTRODES @ \$ 1.00 per pound	\$1000.00
1 ELECTRODE OVEN @ 500.00 each	\$500.00
1000 POUNDS OF CARBON STEEL @ 1.00 per pound	\$1000.00

Summary

The cost of the equipment and supplies used in the development of this project were listed.

CHAPTER FIVE

Conclusions and Recommendations

Introduction

Included in Chapter Five is a presentation of the conclusions gleamed as a result of completing this project. Further, the recommendations extracted from this project are presented. Lastly, the Chapter concludes with a summary.

Conclusions

The conclusion extracted from this project follow.

1. Based on the review of the literature and discussion with the advisory, the current method of teaching shielded metal arc welding curriculum at Palomar College is not longer valid.
2. Students graduating from the Palomar College are not adequately prepared in the basic manipulative skills required in the workplace.

Recommendations

The recommendations resulting from this project follow.

1. The curriculum be reviewed and updated annually to ensure that the students are receiving the most current instruction possible.
2. Funds be set aside on an annual basis so that when the existing programs need to be updated, money will be available. This strategy will ensure that the students are working with the most up-to-date equipment possible

Summary

Chapter Five reviewed the conclusions derived from the project. Lastly, the recommendations culminating from this project were presented.

APPENDIXES: Welding Curricula

APPENDIX A:
Existing Outline--Hobart Welding School

SHIELDED METAL ARC WELDING

BASIC COURSE (140 HOURS)

PREREQUISITES:

The student should be sufficiently mature and should be able to read and write. The welder should have manual dexterity, good eyesight, and good eye-hand coordination. To insure a reasonable degree of success as a welder the prospective student should have finger dexterity, and spatial aptitude in accordance with the General Aptitude Test Battery (GATB) for the occupation of Welder, Arc or the Arc Welding portion of Welder, Combination.

COURSE OBJECTIVE (as given by state employment office):

To be able to perform in accordance with Arc Welder (Dot 810.384-014), Production Line Welder (DOT 819.684-010), Tack Welder (DOT 810.684-010) and the Arc Welding portion of Combination Welder (DOT 819.384-010). This involves welding with the shielded metal arc welding process, all positions, welding on thin and medium thickness of steel, single and multipass using AC and DC welding machines and a variety of covered electrodes.

COURSE CONTENT (description of instructions)

This course provides the student with a thorough technical understanding of arc welding fundamentals, welding safety, arc welding machine, electrode classifications and selection. It also provides training to develop the manual skill necessary to make high quality shielded metal arc welds in all positions on mild steel from 16 gage to 1 inch plate single pass and multiple pass. To weld using mild steel electrodes, low hydrogen electrodes and iron power electrodes using AC and DC welding power sources. It

conforms to the requirements of the US Office of Education 17.230.602.

No.	Course
1.	Lecture/Discussion, "Introduction to Shielded Metal Arc Welding"
2.	Lecture/Discussion, "Safety and Health of Welders"
3.	Strike Arc and Run Bead, Surface Weld, Flat Position
4.	Pad of Beads, Surface Weld flat Position
5.	Fillet Weld, Lap Joint, Horizontal Position
6.	Pad of Beads, Surface Weld, Flat Position
7.	Lecture/Discussion, "Visual Inspection and Practical Weld Tests"
8.	Fillet Weld, Tee Joint, Horizontal Position
9.	Fillet Weld, Tee Joint, Flat Position
10.	String Beads, Plate in Vertical Position, Horizontal Travel
11.	Square Groove Weld, Butt Joint, Horizontal Position
12.	Lecture/Discussion, "Electrode Selection"
13.	Fillet Weld, Lap Joint, Vertical-Up Position
14.	Fillet Weld, Tee Joint, Vertical-Up Position
15.	Fillet Weld, Tee Joint, Vertical-Up Position
16.	Square Groove, Butt Joint , Vertical-Up Position
17.	Lecture/Discussion, "Power Sources for Welding"
18.	Fillet Weld, Lap Joint, Overhead Position
19.	Fillet Weld, Tee Joint, Overhead Position
20.	Fillet Weld, Tee Joint, Overhead Position
21.	Square Groove Weld, Butt Joint, Overhead Position

22. Lecture/Discussion, "Welding Distortion Control"
23. Fillet Weld, Lap and Tee Joints, Flat and Vertical Down Positions
24. String Beads, Flat, Horizontal and Vertical Positions
25. Square Groove Weld, Butt Joint, Flat Position
26. Fillet Weld, Lap Joint, Horizontal Position
27. Lecture/Discussion, "The Low Hydrogen Electrode and Its Use"
28. Fillet Weld, Tee Joint, Vertical-Up Position
29. Fillet Weld, Tee Joint, Overhead Position
30. Fillet Weld, Lap Joint, Horizontal Position, Using E-7018 Low Hydrogen

TESTING:

To pass the course, the student is required to pass: at least four written tests on welding; will have passed both visual and the Modified AWS Fillet Break Test in the Horizontal and Overhead Positions; both visual and Modified AWS Guided Bend Test in the Vertical Up Position.

APPENDIX B:
Existing Outline--Lincoln Welding School

The Lincoln Welding School

The Lincoln Welding School provides an effective foundation for a career in arc welding. This is not a “school” in the ordinary sense of the word, for the instructions are practical with little theoretical work involved. The welding courses, both Basic and Advanced, enable you to learn not only the fundamental principles of arc welding, but also the latest procedures and techniques.

For the industrious individual with welding ambitions, the Welding School offers a real opportunity. Lincoln’s experienced, congenial instructors keep close watch at all times to see that each student progresses. And each student is assigned to his own welding booth and welding machine as his private “shop.”

The fees for the following courses are based on the cost of expenses only. A deposit is required upon registration. This is applied to the total fee. Protective clothing, shields, gloves, etc., can be purchased at low cost.

Basic Course

Five weeks intensive training - 150 hours continuous practice. Subjects include: study of arc-welding machine, its performance and control; practice with bare electrodes - striking the arc, buildup of plates and shafts; practice with shielded-arc electrodes - effect of arc length, current, and speed on bead; sizes and uses of various electrodes; butt-lap-tee-fillet welds in flat, vertical, and overhead positions; sheet-metal welds; “Fleet-Welding” technique; use of iron-powder: “Jetweld” electrodes; penetration cutting.

ARC WELDING THEORY AND TECHNIQUES

Lesson	Title
1.1	Safety Practices in Welding
1.2	The Arc Welding Process
1.3	Arc Welding Machines and Accessories
1.4	The Stick Electrode
1.5	Striking the Arc
1.6	Running a Straight Bead
1.7	Setting the Current
1.8	Restarting a Bead and Filling a Crater
1.9	Weaving a Bead
1.10	Running a Bead with a Whipping Motion
1.11	Building a Pad
1.12	Different Welding Positions and Types of Joints
1.13	Polarity
1.14	Arc Blow
1.15	Welding Heat Input
1.16	Electrode Identification and Characteristics
1.17	Iron Powder Electrodes
1.18	Downhand Lap Welds
1.19	Downhand Fillet Welds
1.20	Downhand Butt Welds
1.21	Horizontal Welds

- 1.22 Horizontal Butt Welds
- 1.23 Running Vertical Down Beads
- 1.24 Vertical Down Lap and Fillet Welds
- 1.25 Vertical Down Butt Welds
- 1.26 Corner Welds
- 1.27 Edge Welds
- 1.28 Welding Thin Gauge Metals
- 1.29 Running Vertical Up Beads
- 1.30 Vertical Up Lap and Fillet Welds
- 1.31 Vertical Up Butt Welds
- 1.32 Running Overhead Beads
- 1.33 Overhead Lap and Fillet Welds
- 1.34 Overhead Butt Welds
- 1.35 Introduction to Welding Symbols
- 1.36 Welding Cast Iron
- 1.37 Welding Higher Carbon and Low Alloy Steels
- 1.38 Low Hydrogen Electrodes
- 1.39 The Arc Torch and the Carbon Arc
- 1.40 Cutting with the Arc
- 1.41 Welding Copper
- 1.42 Principles of Hardsurfacing

APPENDIX C:
Existing Outline--Palomar College

PALOMAR COLLEGE
COURSE OUTLINE OF RECORD FOR
DEGREE CREDIT COURSE

COURSE NUMBER AND TITLE: WELD 100 Welding I

UNIT VALUE: 3 **MINIMUM NUMBER OF SEMESTER HOURS:** 96

BASIC SKILLS REQUIREMENTS: Appropriate language and computational skills.

ENTRANCE REQUIREMENTS:

PREREQUISITE: None.

COREQUISITE: None.

RECOMMENDED PREPARATION: None.

SCOPE OF COURSE:

Oxy-acetylene welding of steel sheet metal and tubing. Oxy-acetylene requisite and machine cutting. Shielded metal arc welding steel sheet metal and plate in the flat and horizontal positions.

SPECIFIC COURSE OBJECTIVES:

Students will:

1. Learn both theoretical and practical skills for welding steel plate and tubing with oxy-acetylene and shielded metal arc processes.
2. Apply knowledge to problem solving and development of solutions to typical welding parameters. Identification of metals and the ability to select the correct alloy for a particular application is also a major goal.

CONTENT IN TERMS OF SPECIFIC BODY OF KNOWLEDGE:

Lecture:

- I. Orientation - Safety
- II. Oxy-Acetylene Equipment
- III. Shielded Metal Arc Electrodes
- IV. Oxy-Acetylene Cutting Equipment
- V. Oxy-Acetylene Flames
- VI. Oxy-Acetylene Filler Wires
- VII. Shielded Metal Arc Electrodes
- VIII. Shielded Metal Arc Polarity
- IX. Shielded Metal Arc Volts - Amps
- X. Shielded Metal Arc Duty Cycle
- XI. Weld Cleaning Tools
- XII. Heating Patterns - Distortion Welds
- XIII. Mid-Term Exam
- XIV. Weld
- XV. Fuel Gases
- XVI. Safety Review
- XVII. Welds
- XVIII. Welding Inspection
- XIX. Welds
- XX. Review

Laboratory:

- I. Oxy-Acetylene Manual Cutting
- II. Oxy-Acetylene Machine Cutting
- III. Oxy-Acetylene Fusion Beads
- IV. Oxy-Acetylene Beading
- V. Oxy-Acetylene Butt Welds
- VI. Oxy-Acetylene Fillet Welds
- VII. Oxy-Acetylene Groove Welds
- VIII. Oxy Acetylene Braze Welding
- IX. Shielded Metal Arc Beading
- X. Shielded Metal Arc Padding
- XI. Shielded Metal Arc Fillet
- XII. Shielded Metal Arc V-Groove
- XIII. Oxy-Acetylene Tubing Welds
- XIV. Oxy-Acetylene Heavy Gauge
- XV. Shielded Metal Arc Vertical

REQUIRED READING:

Oxy-Acetylene Handbook. Second Edition. The Linde Corporation, 1990.

New Lessons in Arc Welding. Lincoln Electric Company, 1988

SUGGESTED READING:

American Welding Society Handbook. Second Edition. American Welding Society, 1988.

The Stabilizer. Lincoln Electric Company, 1990.

Welding Journal. American Welding Society, 1990.

REQUIRED WRITING:

A two page weekly assignment reviewing specified chapters of the required reading textbooks. Assignments are judged by the instructor for content, spelling and correct grammar. Other written work consists of filling out weld procedure forms. These forms enable the student to learn the proper procedure for recording laboratory information regarding welding parameters that need to be addressed in order to successfully complete the welding assignments.

OUTSIDE ASSIGNMENTS:

Reading assignments are from the text and selected readings and should amount to not less than nine hours per week of study.

INSTRUCTIONAL METHODOLOGY:

30 points possible for written assignments

30 points possible for welding lab assignments

15 points possible on the midterm exam

25 points possible on the final exam

APPENDIX D:
Proposed Outline--Palomar College

PALOMAR COLLEGE
COURSE OUTLINE OF RECORD FOR
DEGREE CREDIT COURSE

___ Transfer Course ___ A.A. Degree Applicable Course

(Check all that Apply)

COURSE NUMBER AND TITLE: WELD 100 Welding 100

UNIT VALUE: 3

MINIMUM NUMBER OF SEMESTER HOURS: 96

ENTRANCE REQUIREMENTS:

PREREQUISITE: None

COREQUISITE: None

RECOMMENDED PREPARATION:

SCOPE OF COURSE:

Shielded metal arc principles and practices of welding carbon steel plates and sheet metal in the flat and horizontal positions. Oxyfuel gas principles and practices of welding and cutting carbon steel plates and sheet metal in the flat and horizontal positions.

SPECIFIC COURSE OBJECTIVES:

Students will be able to:

1. Demonstrate skills in personal and shop safety.
2. Demonstrate housekeeping activities.
3. Apply both verbal and written assignments.
4. Perform safety inspections of equipment.
5. Perform minor external repairs to equipment.

6. Demonstrate proper setup of equipment to perform arc welding.
7. Demonstrate proper welding techniques in shielded metal arc welding.

CONTENT IN TERMS OF SPECIFIC BODY OF KNOWLEDGE:

Lecture:

- I. Orientations
- II. Safe practices in arc welding
- IV. Theory and application
- V. Electrical welding power sources
- VI. Electrode classification
- VII. Basic electricity
- VIII. Welding symbols
- IX. Weld discontinuities and defects
- X. Types of joints and positions
- XI. Welding inspection

Laboratory:

- I. Guided tour of laboratory
- II. Welding stringer beads with E-6013
- III. Welding overlap stringer beads with E-6013
- IV. Welding overlap stringer beads with E-7018
- V. Welding horizontal fillet welds with E-7018
- VI. Welding stringer beads with E-6010
- VII. Welding overlap stringer beads with E-6010
- VIII. Welding horizontal fillet welds with E-6010

IX. Welding vertical fillet welds with E-7018

X. Welding vertical fillet welds with E-6010

REQUIRED READING:

Welding Processes, Eight edition, The American Welding Society, Miami, Florida, 1991.

Welding Technology, Eight edition, The American Welding Society, Miami, Florida,

1991.

SUGGESTED READING:

Welding Journal, The American Welding Society, Miami, Florida, 1997.

REQUIRED WRITING:

Demonstrate welding skills would be more appropriate.

INSTRUCTIONAL METHODOLOGY:

200 points possible for safety test

100 points possible for midterm test

200 points possible for final exam

200 points possible for housekeeping

200 points possible for discontinuity identification

1100 points possible for laboratory assignments

IS COURSE REPEATABLE FOR REASON(S) OTHER THAN DEFICIENT

GRADE? ___ Yes ___ No Number of times course may be taken for credit: 1.

If yes, Identify specific provisions of Title 5 Division 2 sections(s) 55761-55763 and

58161 which qualifies course as repeatable:

CONTACT PERSON: Jay Miller

SIGNATURES:

By signing this form, I certify that this course outline of record meets all the minimum requirements for associate degree courses as specified in Title 5 Sec. 55002.

Prepared

by: _____

(signature)

(date)

Department

Chairperson/Director: _____

(signature)

(date)

Division

Dean: _____

(signature)

(date)

Curriculum Committee

Representative: _____

(signature)

(date)

Course outlines of record should be reviewed and revised as necessary.

note: Some revisions to course outlines of record require Curriculum Committee approval, others may not. Please consult your dean or the Instruction Office if you need assistance.

WELDING 100

Welding I

Course Syllabus

Developed by

Jay Miller

The purpose of the Welding 100 course is to provide entry level training in shielded metal arc welding on carbon steel plates and sheet metal in the flat and horizontal positions.

Student	_____
Semester	_____
Location	_____
Instructor	_____
Class Hours	_____
Office Hours	_____
Telephone	_____
Mail	_____ _____ _____

Department of Welding Technology

Palomar College, San Marcos

Introduction

Entry Level Welder

An entry level welder is a person considered to possess a prerequisite amount of attitudes, knowledge, and skills to perform proceduralized tasks involving motor skills and theoretical knowledge while working under close supervision.

Course Description

Welding 100 is the first course in the Certificate in Welding Technology program at Palomar College. It is the prerequisite to all welding courses at the college. Students should plan to complete Welding 100 in order to enroll in the advanced welder training courses. Welding 100 is a course focusing on the development of safe attitudes, theory, and application of shielded metal arc electrodes on carbon steel plates and sheet metal in the flat, horizontal, and vertical positions.

Justification

Students majoring in welding technology need an understanding of the technical aspects of welding as well as the techniques used to gain control of the molten welding pool. Most welders develop satisfactory psychomotor skills in welding, but lack knowledge about welding technology and procedures in general. The changes and demands of the qualifications and certifications of welders in industry make it imperative that students understand the procedures and codes by which they will perform and be judged.

Educational Objectives

Having successfully completed Welding 100, the student will be able to:

1. Perform safety inspections of equipment and accessories.
2. Make minor external repairs to equipment and accessories.

3. Set up for shielded metal arc welding operations on plain carbon steel.
4. Operate shielded metal arc welding equipment
5. Apply pad welding beads in the flat position using E-6013, E-6010, and E-7018 electrodes.
6. Apply fillet welds, in the flat, horizontal, and vertical positions using E-6010 and E-7018 electrodes.
7. Explain the electrode classification system.
8. Describe the different welding power sources.
9. Describe weld discontinuities and defects.
10. Describe the equipment in shielded metal arc welding.
11. Explain the electrical components and theory in shielded metal arc welding.
12. Describe the historical development of welding.

Rules and Regulations

In order to maintain a productive and safe learning environment and make life a little more enjoyable for everyone, students in the Welding 100 course are expected to comply with all of the following rules:

1. Students are expected to pass the written safety test with 100% accuracy before participating in laboratory exercises.
2. Students are expected to complete assignments on the due date indicated on the class schedule. Late work will eliminate the possibility of earning an "A" grade.
3. Students are expected to arrive on time and be prepared for each class and laboratory session. Each student is responsible for everything indicated in the Class Schedule. If a student is absent, he/she is still responsible for whatever information was presented

- in class. The instructor does not reteach class sessions on an individual basis.
4. Students are required to pay a material fee of 25 dollars before receiving supplies and materials.

Competency Certification

The Welding 100 course has been designed to insure that the students who successfully complete all of the assignments will have mastered the competencies listed in the section entitled “Education Objectives.” In order to successfully complete Welding 100, students must demonstrate competency in all of the areas listed on the Certification of Competency on the following page.

CERTIFICATE OF COMPETENCY

This is to certify that

WASGONNA YEABUTTS

**Successfully completed the WELD 100 Welding course and has
demonstrated the ability to do each of the following:**

- *Describe the historical development of arc welding.**
- *Perform safety inspections of equipment and accessories.**
- *Make minor repairs on equipment and accessories.**
- *Setup equipment for shielded metal arc welding.**
- *Operate shielded metal arc welding equipment.**
- *Apply pad of beads with E-6013, E-6010, and E-7018 electrodes.**
- *Apply fillets welds in all positions using E-6013, E-6010, E-7018 electrodes.**
- *Describe the electrode classification system.**
- *Describe the different welding power sources.**
- *Identify the different power sources.**
- *Identify and describe weld discontinuities and defects.**
- *Describe the equipment used in shielded metal arc welding.**
- *Describe the electrical components in shielded metal arc welding.**

Welding 100 Instructor

Date

Palomar College, San Marcos, California

Grade Information

Student grades for Weld 100 will be awarded on the basis of class participation, laboratory participation, and ability to demonstrate mastery of all basic course competencies. The instructor will evaluate all completed assignments and will indicate the number of points earned based on the evaluation criteria for each assignment. Course assignments and grading scale follow.

1. Safety test	100
2. Welding knowledge	100
3. Safety inspections of equipment	100
4. Setup equipment for welding	100
5. Pad of beads with E-6013	100
6. Pad of beads with E-6010	100
7. Pad of beads with E-7018	100
8. Overlap beads with E-7018	100
9. Fillet weld with E-6010	100
10. Fillet weld with E-7018	100
11. Identify weld discontinuities and defects	100
12. Clean and prepare booth for next semester	100

The following grading scale will be used to determine the final grades of Weld 100 students. The number of points earned by the student divided by the maximum points allowed will be used to calculate a percentage. This percentage will then be translated into a final grade.

A = 100% - 90%

B = 89% - 80%

C = 79% - 70%

D = 69% - 60%

F = Below 60%

Required Text:

Welding Processes, Eighth edition, The American Welding Society, Miami, Florida, 1991.

Welding Technology, Eighth edition, The American Welding Society, Miami, Florida, 1991.

Lecture Topics and Required Reading:

1. Safety

Read Welding Technology, pages 519-550

2. Historical development of welding

3. Theory and application

Read Welding Technology, pages 1-63

4. Power sources

Read Welding Processes, pages 1-41

5. Electrode classification

6. Basic electricity

Read handouts

7. Welding symbols

Read Welding Technology, pages 193-212

8. Inspection

WELD 100 ACHIEVEMENT RECORD

STUDENT_____ **SEMESTER**_____

INSTRUCTOR_____ **SECTION**_____

Competency	Rating	Score	Date Completed	Instructor's Initials	Trainee's Initials
Safety test	200				
Safety inspection	100				
Minor repairs	100				
Setup equipment	100				
Midterm test	100				
6013 Pad	100				
6010 Pad	100				
7018 Pad	100				
6013 Overlap	100				
6010 Overlap	100				
7018 Overlap	100				
6010 Fillet weld	100				
7018 Fillet weld	100				
Discontinuities	200				
Housekeeping	200				
Final exam	200				
Possible total	2000				
Earned				Grade	

References

- The American Welding Society (1991). Welding Processes (8th ed.). Miami: The American Welding Society.
- The American Welding Society (1994). Standard Welding Terms and Definitions (8th ed.). Miami: The American Welding Society.
- The American Welding Society. (1993, April). Welding: Land of Opportunities. Miami: The American Welding Society.
- The Holy Bible. New York: 1952.
- The Lincoln Electric Company (1995). The Procedure Handbook (13th ed.). Cleveland: The Lincoln Electric Company.
- The Miller Electric Manufacturing Company (1995). Welding and the World of Metals (6th ed.). Appleton: The Miller Electric Manufacturing Company.